Madison River/Ennis Reservoir Fisheries

and

Madison River Drainage Westslope Cutthroat Trout Conservation and Restoration Program

2002

Annual Report
to
PPL Montana
Environmental Division
Butte
www.pplmontana.com

and

Turner Enterprises, Inc.
Bozeman

by

Pat Clancey
Montana Fish, Wildlife, & Parks
Ennis
March 2003

Montana Fish, Wildlife & Parks
www.fwp.state.mt.us

INTERNET WEB PAGES CITED IN THIS REPORT
(in alphabetical order)

Aquatic Nuisance Species Task Force……..www.anstaskforce.gov
Montana Fish, Wildlife, & Parks……..www.fwp.state.mt.us
New Zealand Mudsnail in the Western USA…….. www.esg.montana.edu/aim/mollusca/nzms
PPL Montana……...www.pplmontana.com
Protect Your Waters……www.protectyourwaters.net
Whirling Disease Task Force…….. whirlingdisease.org

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EXECUTIVE SUMMARY

One young-of-the-year Arctic grayling and two young-of-the-year whitefish were captured during seining in Ennis Reservoir in 2002. Several anglers reported catching adult grayling in the Madison River south of Ennis throughout the summer (as far south as McAtee Bridge), as well catching adult and young-of-the-year grayling at the inlet of Ennis Reservoir. Populations of both yearling and two year old & older rainbow trout in the Pine Butte section in 2002 were virtually unchanged from 2001 levels. Rainbow trout in Varney exhibited a noticeable increase in the number of two year old & older fish, but yearlings remained at a level similar to the previous year. The rainbow trout population in Norris showed a moderate decrease. Two year old & older brown trout numbers in all three sections were within the historic long-term range. Preliminary analyses indicate no difference in growth rates for either rainbow or brown trout between the upper and lower Madison River. Twelve fish in the Bypass Reach were implanted with radio transmitters to monitor their movements seasonally and in response to flow changes. Results of analyses of 2001 Madison River Whirling Disease sentinel fish show that infection was high that year. Water temperature was monitored at 14 sites throughout the Madison River, and air temperature at 7 sites. Bioassays showed that exposure to 48 exposure-units of the molluscicide Bayluscide killed 100 percent of tested New Zealand Mud snails, but that neutralization of the Bayluscide with potassium permanganate was slow. Samples collected in August 2001 documented the presence of New Zealand Mud snails in the Madison River near the Norris Bridge, only a few miles upstream of the Darlinton Ditch head gate. The July 2001 Decision Notice for the Darlinton Ditch New Zealand Mudsnail control project approved proceeding with eradication of New Zealand Mud snails in Darlinton Ditch pending the results of bioassays. Due to the long neutralization time required for Bayluscide and the arrival of New Zealand Mud snails in the lower Madison River, a decision was made not to proceed with the treatment. In late March, the Montana First Judicial District Court ruled against the litigants in their suit on the Cherry Creek Native Fish Introduction Project, allowing the project to proceed. The project was again postponed due to threatened litigation in federal court after the state court decision, however, the litigants did not file the threatened lawsuit in federal court in 2002. The litigants had previously filed litigation in federal court in October 2000, but later withdrew it. Gametes were successfully collected from two populations of westslope cutthroat trout for development of a broodstock for the Madison Drainage Westslope Cutthroat Trout Conservation & Restoration Program. The Environmental Assessment prepared to evaluate alternatives for removing hybrid and pure fish from the Sun Ranch rearing pond received no public comment, therefore a decision was made to proceed with the treatment. The treatment was conducted in late February. All sentinel fish in the pond died from antimycin toxicity while all sentinel fish in the pond outflow survived until they were removed in late April. Rainbow trout redds were observed in 9 of 11 surveyed Hebgen Reservoir tributaries, with almost 4400 redds enumerated. Habitat surveys of Indian Creek, a Madison River tributary, revealed little available spawning habitat for trout even if flow restoration occurred. The River Network spearheaded the purchase of property at $3 Bridge and Montana Trout Unlimited organized and lead the effort to rehabilite aquatic habitat in $3 Spring Creek.

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INTRODUCTION

Montana Fish, Wildlife, & Parks (MFWP) has conducted fisheries studies in the Madison River Drainage since 1990 to assess the status of the Arctic grayling (*Thymallus arcticus*) population of Ennis Reservoir, and to address effects of hydropower operations at Hebgen and Ennis dams on fisheries (Byorth and Shepard 1990, MFWP 1995, MFWP 1996, MFWP 1997a, MFWP 1998, MFWP 1999, MFWP 2000, MFWP 2001a, MFWP 2002a). This work has been funded through an agreement, initially with Montana Power Company (MPC), now with PPL Montana, owner and operator of the dams. The original agreement between MFWP and MPC was designed to anticipate relicensing requirements for MPC's hydropower system on the Madison and Missouri Rivers, which includes Hebgen and Ennis dams, as well as seven dams on the Missouri River (Figure 1). PPL Montana has maintained the direction set by MPC, and convened several committees to address fisheries, wildlife, water quality, and recreation issues related to the operation of the hydropower facilities on the Madison and Missouri rivers. These committees are composed of representatives of PPL Montana and several agencies. Each committee has an annual budget and authority to spend money that is provided to them by PPL Montana to address the requirements of PPL Montana's FERC license for operating the Madison & Missouri dams. The Madison Fisheries Technical Advisory Committee (MadTAC) is composed of personnel of PPL Montana, MFWP, the U.S. Fish & Wildlife Service (USFWS), the U.S. Forest Service (USFS), and the U.S. Bureau of Reclamation (BLM). Each entity has equal authority in decision making within the TAC. Collectively, the nine dams on the Madison and Missouri rivers are called the 2188 Project, which refers to the Federal Energy Regulatory Commission (FERC) license number that authorizes their operation. The Federal Energy Regulatory Commission issued PPL Montana a license to operate the 2188 Project for 40 years (Federal Energy Regulatory Commission 2000). The license details the terms and conditions PPL Montana must meet during the license term, including fish, wildlife, and recreation protection, mitigation, and enhancement measures.

Late in 1996, MFWP initiated a program entitled "The Madison River Drainage Westslope Cutthroat Trout Conservation and Restoration Program". The goal of this effort is to conserve and restore the native westslope cutthroat trout (*Oncorhynchus clarki lewisi*) in the Madison River drainage. Fieldwork for this effort began in 1997 in tributaries of the Madison River. The agreement between MFWP and PPL Montana includes provisions to address issues regarding species of special concern.

In recognition of the severity of the situation faced by the westslope cutthroat trout, and in keeping with the philosophy of promoting native species on their properties, Turner Enterprises, Incorporated (TEI) offered access to the Cherry Creek drainage on the Flying D Ranch to assess its suitability for introducing westslope cutthroat. MFWP determined in 1997 that introducing westslope cutthroat to Cherry Creek is feasible, but would require the removal of all non-native trout presently in that portion of the drainage. MFWP, TEI, and the Gallatin National Forest (GNF) subsequently entered into an agreement to pursue this effort. The agreement outlines the roles and responsibilities of each party, including the GNF, which manages the public land at the upper end of the Cherry Creek drainage.

The Sun Ranch has entered into an agreement to assist MFWP with westslope cutthroat trout conservation and recovery. The ranch built a small hatchery facility and a rearing pond to

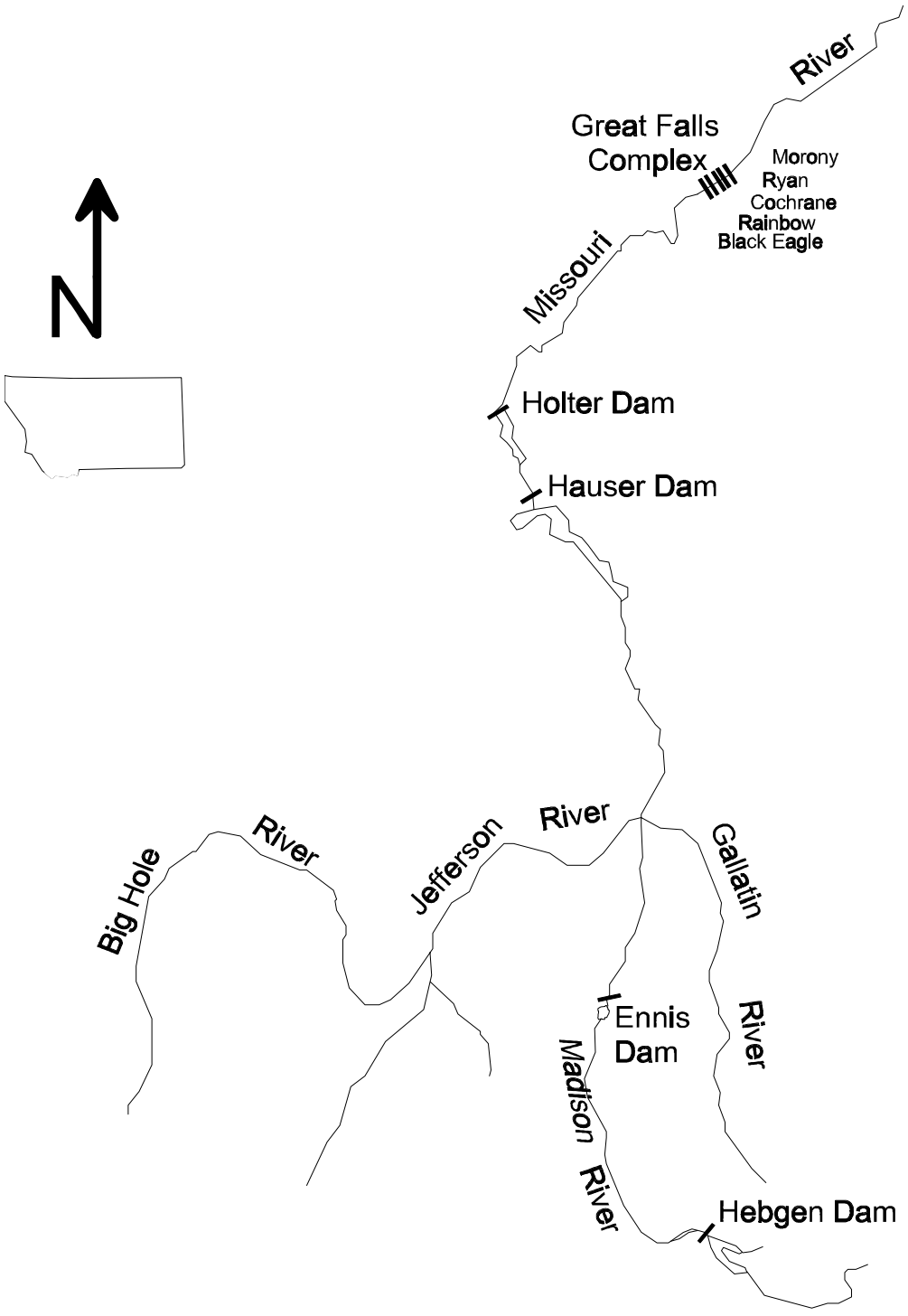

Figure 1. Locations of PPL Montana dams on the Madison and Missouri rivers.

facilitate development of a westslope cutthroat trout broodstock for the Madison and Missouri river drainages, and provided personnel to assist with fieldwork and conduct hatchery operations.

METHODS

Madison Grayling

A beach seine (Figure 2) is used to monitor index sites in Ennis Reservoir (Figure 3) for young-of-the-year grayling and other fish species. A 125'x 5'x ¼" mesh seine with a 5'x 5'x 5' bag is fed off a moving boat in water up to five feet deep, with a worker in the water at each end of the seine. The seine is pulled through shallow water near the shoreline for some distance, then onto the shoreline where captured fish are enumerated by species. If beds of macrophytes (aquatic plants) where juvenile fish are likely to rear are present and accessible, the seine is pulled through them.

Figure 2. Beach seining in Ennis Reservoir.

Population Estimates

Electrofishing from a driftboat mounted mobile anode system (Figure 4) is the principle method used to capture Madison River trout for population estimates (Figure 5). Fish captured for population estimates are weighed and measured, marked with a fin clip, and released. A log-likelihood statistical analysis (MFWP 1997b) is used to estimate trout populations in several sections of the Madison River (Figure 5). Yearling fish are distinguished from two year old & older fish by taking a scale sample from up to ten of each species per half-inch group, making an impression of the scale in acetate, projecting the impression on a microfiche reader, and interpreting the age of the fish from the scale impression. Generally, the number of two year old & older fish is

Figure 3. Locations of Ennis Reservoir seining sites.

Figure 4. Electrofishing (shocking) in the Norris section of the Madison River.

a better indicator of year class strength and subsequent reproductive potential. Yearling numbers serve as an after-the-fact measure of the impact of whirling disease on reproductive success the previous year. Aging is not complete for samples collect from 2000 - 2002, so fish from 5.0 to 9.9 inches are used to estimate yearling abundance, and fish larger than 9.9 inches are assumed to be two-year-old & older for those years. The estimates may change after aging is completed.

Trout Growth

Comparison of trout growth in sections of the upper and lower Madison River was initiated in 2002. Preliminary analyses were conducted by plotting average weight versus average length of 2, 3, 4, and 5 year-old rainbow and brown trout in the Pine Butte, Varney, and Norris sections (Figure 5). These preliminary analyses used average weight and average length of aged fish for comparison. Age was not incorporated into the analyses. Ongoing analyses are examining weight-at-length by size class and weight-at-length by age class.

Whirling Disease

Sentinel fish live-cage studies were conducted in the Madison River at established sites. Cages containing 60 young-of-the-year rainbow trout were placed at selected locations for multiple 10-day periods to conduct time-series tests.

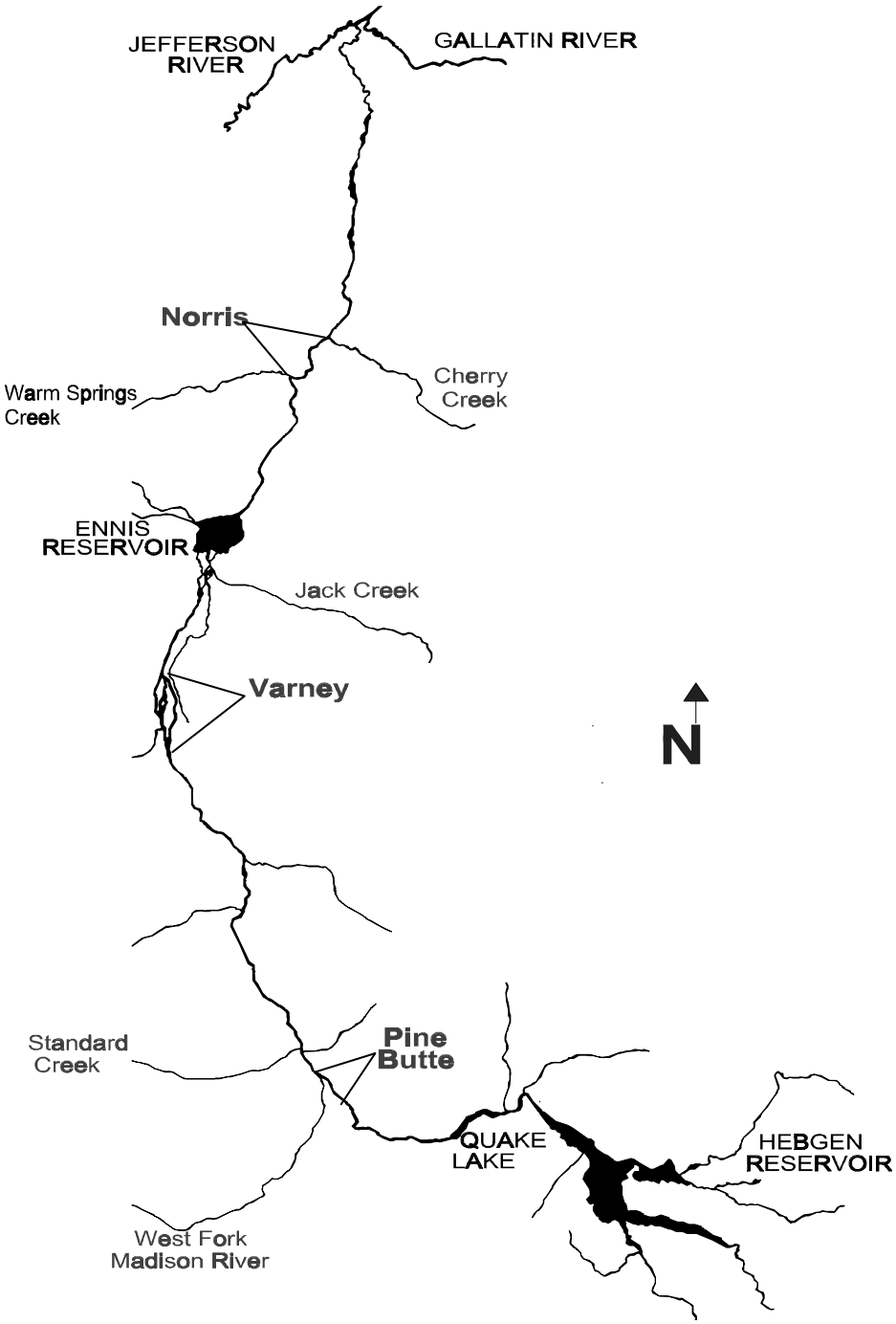

Figure 5. Locations of Montana Fish, Wildlife, & Parks 2002 Madison River population estimate sections.

Madison Bypass

In 2002 a remote radio telemetry monitoring system was installed in the Bypass Reach of the Madison River between Ennis Dam (Figure 6) and Madison Powerhouse to assess fish movement seasonally and in response to changes in river discharge. Radio telemetry receivers are located at two sites to allow monitoring at the upstream and downstream ends of the Bypass. Two antennae are wired into each receiver, with one antenna set to detect transmitters at the base of the dam, one antenna set to detect transmitters at the powerhouse 1.4 miles downstream from the dam, and two antennae set at points between the dam and powerhouse. Each of these antenna detect the transmitter signal only if the fish moves into a narrow section of the river the antenna is set to monitor.

Figure 6. Ennis Dam on the Madison River. The gray metal pipeline (penstock) on the left transports water from Ennis Reservoir to the Madison Powerplant, approximately 1.4 miles downstream from the dam.

Coded radio transmitters were implanted in two brown trout in July, and radios were secured to locations on the riverbank near each of the four the antennae to test the system. Deployment of additional transmitters in fish was delayed until November when water temperatures and Bypass flows were low enough to accommodate electrofishing. In November 10 additional transmitters were deployed in the Bypass. In all, transmitters were implanted in 6 rainbow trout, 5 brown trout, and one mountain whitefish (Table 1). All transmittered fish swam away vigorously after recovery from the implant procedure. The transmitters have a rated life of 265 days. The transmitters weigh 7.7 grams. A rule-of-thumb states that the transmitter should weigh no more than 2 percent of the fish's weight, so this means that the smallest fish to receive a transmitter should weigh no less than 385 grams (0.85 lbs).

Table 1. Statistics of fish implanted with coded radio transmitters in the Bypass Reach of the Madison River, 2002.

Species	length (inches)	weight (lbs)	transmitter/fishweight
rainbow trout	13.5	1.14	1.5 %
rainbow trout	13.9	1.15	1.5%
rainbow trout	15.0	1.28	1.3%
rainbow trout	15.2	1.36	1.2%
rainbow trout	13.7	0.95	1.8%
rainbow trout	12.5	0.85	2.0%
brown trout	14.7	1.15	1.5%
brown trout	14.4	1.18	1.4%
brown trout	13.4	1.05	1.6%
brown trout	13.8	1.00	1.7%
brown trout	14.3	1.08	1.6%
mountain whitefish	16.3	1.65	1.0%

To implant the transmitter, fish are anesthetized to facilitate handling during the implant procedure. After the fish is anesthetized, it is placed ventral side up in a tray containing river water and it's head is submersed. A small incision is made on the ventral side of the fish anterior to the pelvic girdle, and the skin posterior to the pelvic girdle is broken with the scalpel. A grooved director is inserted into the body cavity through the anterior incision and fed posteriorly past the pelvic girdle. It is used to capture the tip of a catheter needle that is inserted behind the pelvic girdle and directed anteriorly (Figure 7). This method prevents the sharp tip of the catheter needle from injuring the internal organs of the fish. The transmitter antenna is inserted into the catheter tip and fed posteriorly until the transmitter is inserted into the body cavity (Figure 8). The grooved director and catheter needle are removed from the fish and the incision is closed with surgical staples or sutures (Figure 9). The actual implant procedure, from placement of the fish into the surgical tray to release into the recovery cage, lasts approximately one minute. Fish are held in a live cage until fully recovered. Prior to being released, the incision is examined to insure the closure is secure.

Temperature Monitoring

Water temperature was recorded at 14 sites and air temperature at seven sites throughout the course of the Madison River from above Hebgen Reservoir to the mouth of the Madison River at Headwaters State Park (Figure 10). Optic StowAway temperature loggers recorded temperature in Fahrenheit every 30 minutes. Air temperature recorders were placed in areas that were shaded 24 hours per day. Intensive monitoring is conducted to corroborate previous modeling, to continue building the data set for the model, and to monitor the effectiveness of measures designed to reduce high temperature impacts to aquatic life.

Figure 7. Catheter needle and grooved director being set in place to implant a radio transmitter in a rainbow trout in the Bypass Reach of the Madison River.

Figure 8. Radio transmitter being placed in a rainbow trout. Note the transmitter antenna exiting the body cavity and trailing behind the pelvic fins.

Figure 9. Stapled incision on a rainbow trout after implantation of a radio transmitter in the Bypass Reach of the Madison River.

Biological and Biocontaminant Monitoring

As part of its relicensing effort, PPL Montana initiated a water-quality monitoring program in 1994. In this program, personnel of PPL Montana and several agencies, including MFWP, conducted biological and biocontaminant monitoring collections at locations within the Madison/Missouri System. Aquatic invertebrate and periphyton samples are collected for biological trend monitoring and contaminant analyses at eight sites from the Madison River within Yellowstone National Park (YNP) to the Missouri River below Morony Dam at Great Falls, and at three additional sites in the Madison River as part of a flushing flow study. Samples are analyzed by a variety of consultants, and results reported to the PPL Montana Environmental Division.

An Environmental Assessment (EA) examining the alternatives and feasibility of eradicating New Zealand Mudsnails from Darlinton Ditch was prepared and released for public comment in May, 2001 (MFWP 2001b). A Decision Notice was issued in July, 2001 (MFWP 2001c) stating that the project would proceed pending the results of bioassays to determine the concentration of Bayluscide necessary to kill NZMS, effective treatment time, and neutralization techniques. Five sets of bioassays were conducted between December 2001 and August 2002. To conduct the bioassays, NZMS and water from Darlinton Ditch were collected and transported to a lab facility in Helena. Twenty NZMS were placed in quart jars and exposed to various concentrations of Bayluscide for up to 24 hours, then placed in fresh water for 24 –136 hours to determine if they would recover from the treatment. All jars were aerated and included a sprig of aquatic vegetation to provide food to the snails. Following similar procedures, additional bioassays were conducted to test the ability of potassium permanganate to neutralize the Bayluscide.

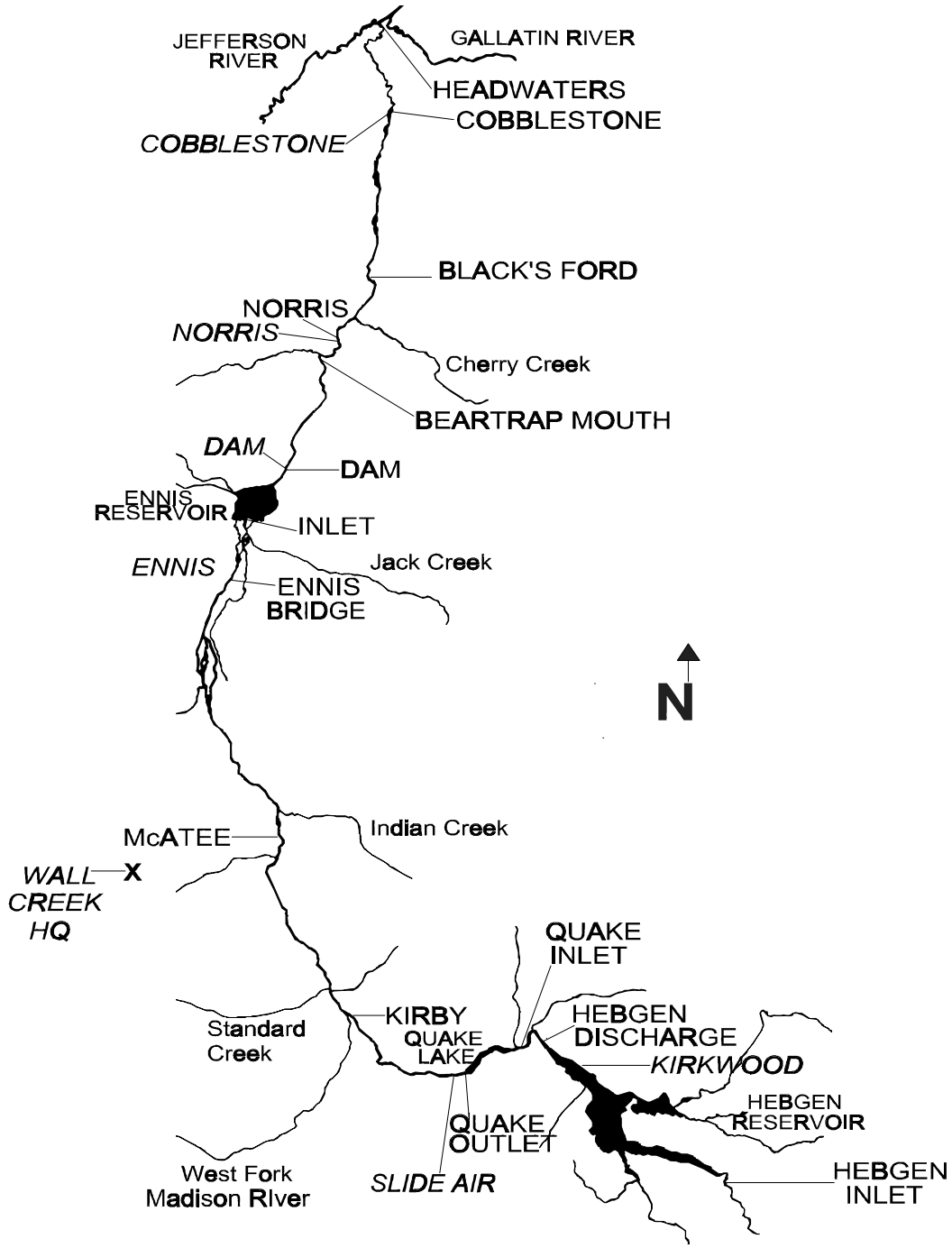

Figure 10. Locations of Montana Fish, Wildlife, & Parks 2002 temperature monitoring sites. Air temperature sites are italicized.

Personnel from Montana State University are conducting research at Darlinton Ditch to compare the impacts of the NZMS on other aquatic biota. Sampling is being conducted in areas of the ditch occupied by NZMS and in upstream areas not occupied by NZMS.

A low power radio broadcast system called a Traveler Information System (TIS) was purchased and installed near West Yellowstone. The TIS will be used to notify anglers and water recreationists of the presence of NZMS in the Madison River and Hebgen Reservoir, and to instruct them on methods of reducing the likelihood of transporting NZMS and other Aquatic Nuisance Species (ANS) to other waters. Additional messages may also be broadcast by the system, including messages on whirling disease, zebra mussels, weed control, and TIPMont, the FWP hotline to report hunting & fishing violations. The system broadcast at the AM frequency of 1600 KHz and is expected to be in operation in the spring 2003. Funding for the purchase, installation, and signage (Figure 11) of the system was provided by a $9,800 grant from the Pacific States Marine Fisheries Commission as part of an effort to prevent the westward spread of zebra mussels. After spring thaw, signs will be posted on U.S. 287 (north & south bound traffic) and Montana 20 (east & west bound traffic) near West Yellowstone.

Figure 11. Roadside sign announcing the Traveler Information System at West Yellowstone.

A working group comprised of personnel from state and federal agencies and private organizations, including FWP and PPL Montana, produced the Montana Aquatic Nuisance Species Management Plan (Montana Aquatic Nuisance Species Technical Committee 2002). Examples of ANS are zebra mussels, NZMS, whirling disease, grass carp, spiny waterflea, rusty crayfish, and Eurasian watermilfoil. The goal of the Montana Aquatic Nuisance Species Management Plan is to minimize the harmful ecological, economic, and social impact of ANS through prevention and management of introduction, population growth, and dispersal into, within, and from Montana. The Plan includes a system to classify all nonindigenous aquatic species in Montana, identifies the proper management for each class, details current authorities and programs, and sets objectives that will lead to the accomplishment of the Plan goal.

Westslope Cutthroat Trout Conservation and Restoration

Efforts to conserve and restore genetically pure westslope cutthroat trout in the Madison Drainage center on maintaining high quality stream habitat in Madison River tributaries, adequate instream flow, and removal of competing or hybridizing non-native trout where necessary. Stream habitat surveys were conducted throughout much of the Madison Drainage from 1997 – 1999

(MFWP 1998, Sloat et al. 2000). Backpack electrofishing was used to survey fish species. Removal of non-native species will require use of the pesticides rotenone or antimycin.

The Montana First Judicial District Court issued its ruling on the Cherry Creek Native Fish Introduction Project in March 2002.

In 2001, the Sun Ranch, LLC, constructed a small hatchery and a rearing pond for use in the Madison Drainage Westslope Cutthroat Trout Conservation and Restoration Program. The intent of the program is to restore genetically pure westslope cutthroat trout to tributaries of the Madison River by taking gametes from nearby populations and developing a local broodstock. The broodstock will be held in the pond at the Sun Ranch. In the first year of the program, gametes were successfully collected from Papoose Creek and the upper Middle Fork of Cabin Creek for development of a local westslope cutthroat trout broodstock. Papoose Creek fish were found to be hybridized with rainbow trout, and were less than 90 percent westslope cutthroat. Upper MF Cabin Creek fish were found to be 100 percent westslope cutthroat trout. Based on this information, the Papoose Creek eggs and fry were purged from the hatchery. In September 2001, the remaining 356 fish were stocked into the Sun Ranch pond. In November, examination of the hatchery records revealed a record-keeping error that resulted in 105 Papoose Creek fish being labeled as Cabin Creek fish. To prevent the hybrid fish from incorporating into the broodstock, it was determined that all the fish would need to be removed from the pond. An EA was prepared to examine the impacts of the project and to explore alternative methods of removing the fish (MFWP 2001d). Removal of the fish by any capture method was ruled out because of the uncertainty of capturing all the fish in the pond, and inefficiency of these methods. It was determined that use of a fish toxicant was the only feasible method available that would result in complete eradication of the fish in the pond. Fintrol (active ingredient antimycin) was the fish toxicant selected for use in the project and evaluation in the EA. The EA was released for public review and comment on December 21, 2001. No public comments were received, so a decision was made to conduct the treatment (MFWP 2002b). On February 23, 3-inch albino rainbow trout were obtained from the Ennis National Fish Hatchery and deployed in minnow traps at three locations in the pond and at one location in the outlet stream (Figure 12). These fish served as sentinel fish to monitor the effectiveness of the treatment. Albino rainbow trout were chosen as sentinel fish so that in the event of an escape from the sentinel cages, they would stand out and be vulnerable to predation. The project was conducted on February 28, 2002.

Assisted by personnel from the Sun Ranch, LLC, and the Gallatin National Forest, MFWP collected gametes in 2002 from wild cutthroat trout in the West Fork of Wilson Creek in the Gallatin Drainage and in the upper portion of the Middle Fork of Cabin Creek in the Madison Drainage. Adult fish were spawned on site and the fertilized eggs transported to a hatchery facility provided by the Sun Ranch. Tissue samples were collected from adult fish for genetic analyses. Individual parental crossings were held separately until results of genetic sampling were available.

Figure 12. Albino rainbow trout used as sentinel fish during the Sun Ranch Pond treatment.

Hebgen Reservoir Tributary Spawning

Use of Hebgen Reservoir tributaries by spawning rainbow trout is being evaluated through a Master of Science Project at Montana State University. The MadTAC is funding over 70 percent of the cost of the two-year project. The project is entitled "An Assessment of Tributary Potential for Wild Rainbow Trout Recruitment in Hebgen Reservoir, Montana." The goal of the project is to assess the potential for wild trout recruitment to Hebgen Reservoir from tributaries and to identify potential limiting factors. A progress report for 2002 is available (Watschke and McMahon 2002).

Madison River Tributary Enhancement

Discharge measurements were conducted at two points on Indian Creek to determine the volume of water necessary to maintain viable fish habitat. Standard USGS methodology for measuring streamflow was used. All measurements were taken downstream of irrigation withdrawal sites, which are just below the mouth of Indian Creek Canyon in the Madison Mountain Range. Indian Creek was surveyed for availability of spawning gravel from above the Wilderness boundary to the Madison River.

The River Network and Montana Trout Unlimited led an effort to purchase the Candlestick Ranch, including property along Three Dollar ($3) Spring Creek, and place an easement on it. This effort guarantees perpetual public access to $3 Spring Creek and the Madison River at $3 Bridge. Montana TU also spearheaded habitat rehabilitation of $3 Spring Creek.

RESULTS AND DISCUSSION

Madison Grayling

Beach seining in Ennis Reservoir was conducted in October. One young-of-the-year Arctic grayling (Figure 13) and two young-of-the-year whitefish (*Prosopium williamsoni*) were captured. Several young-of-the-year brown trout and several hundred young-of-the-year white sucker (*Catostomus commersoni*), longnosed sucker (*Catostomus catostomus*), and Utah chub (*Gila atraria*) were captured, as well as one 18-inch rainbow trout. Site descriptions, dates, catches, and additional photographs are in Appendix A.

In October, an angler reported sighting a school of young-of-the-year Arctic grayling in the main channel of the river just above Ennis Reservoir. He confirmed his identification by catching a few of the schooled fish on rod & reel (Eric Shores, pers.comm. 2002).

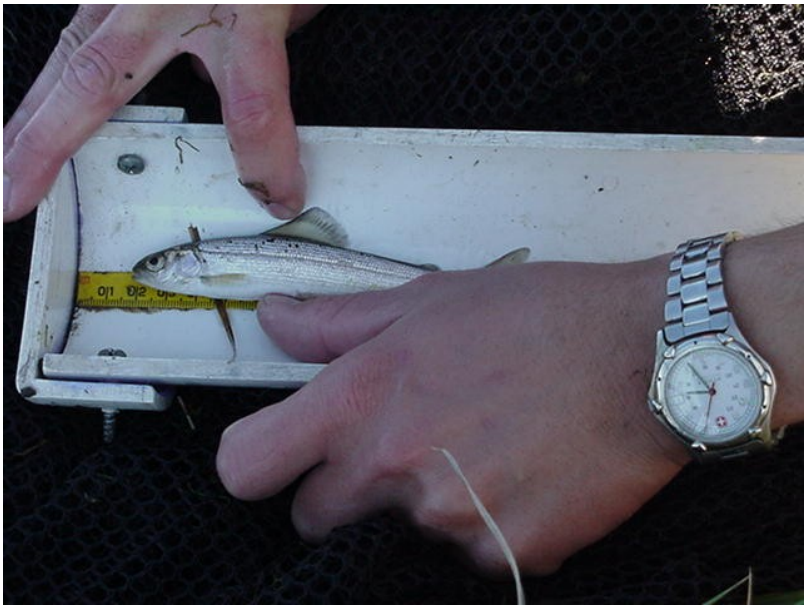

Figure 13. Young-of-the-year arctic grayling captured during beach seining in Ennis Reservoir. Note the large dorsal fin.

Population Estimates

Population estimates were conducted in the Norris section in March and in the Pine Butte and Varney sections in September (Figure 5). Aging of samples collected from 2000-2002 is not complete except in the Norris section. Until age sample analyses are complete, estimates are provisional.

In the charts illustrating annual population trends, stacked bars represent yearling and age 2 & older classes, with the top of the combined bars depicting the total population. Because Norris

estimates are conducted in March each year, yearling fish are too small to capture in adequate numbers to derive an estimate of their abundance.

Figures 14-16 illustrate historic population levels of rainbow trout per mile. In Pine Butte and Varney, the 2002 yearling cohort is similar to the level seen in 2001. Numbers of adult rainbow trout in Pine Butte were at moderate levels while Varney exhibited a marked increase since 2001. Rainbow trout in the Norris section remained at a moderate level.

Brown trout numbers per mile are illustrated in Figures 17-19. In the upper river in 2002, two-year-old and older brown trout remain abundant, and yearling numbers are strong. Brown trout numbers in the Norris section below Ennis Reservoir remained similar to those seen in recent years.

Appendix B contains historic population levels of two year old & older rainbow and brown trout (+ 80% C.I.) for each section.

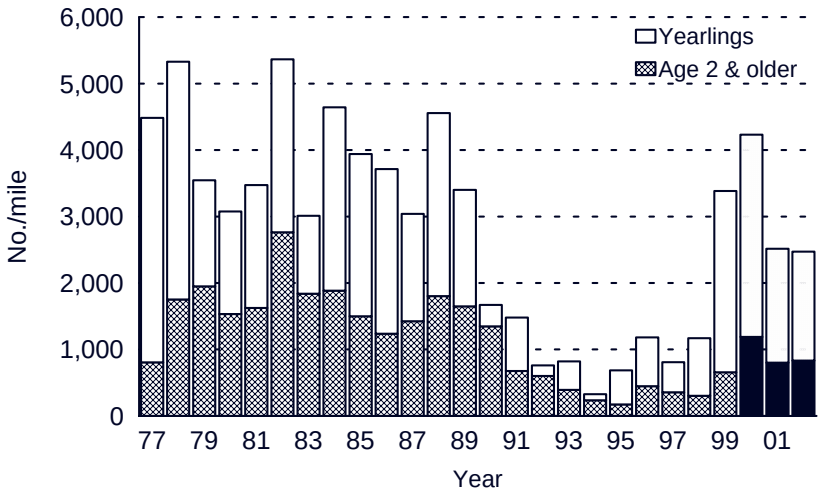

Figure 14. Rainbow trout populations in the Pine Butte section of the Madison River, 1977-2002, fall estimates. Data for 2000 - 2002 are provisional pending completion of age samples.

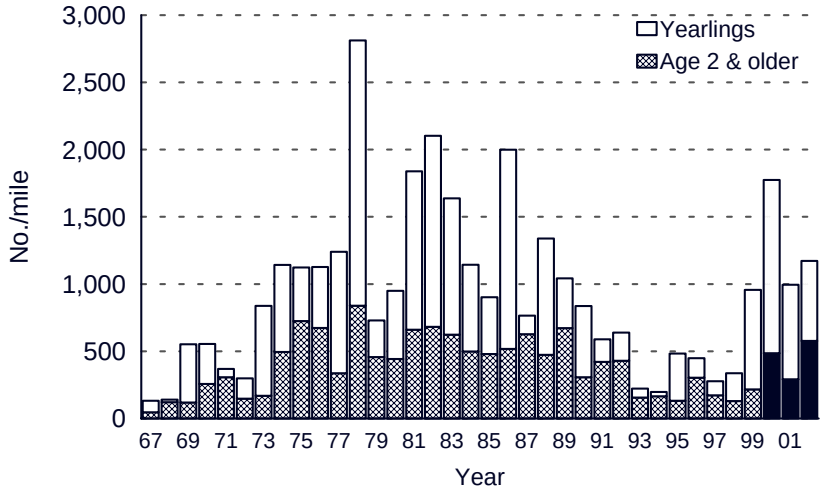

Figure 15. Rainbow trout populations in the Varney section of the Madison River, 1967-2002, fall estimates. Data for 2000 - 2002 are provisional pending completion of age samples.

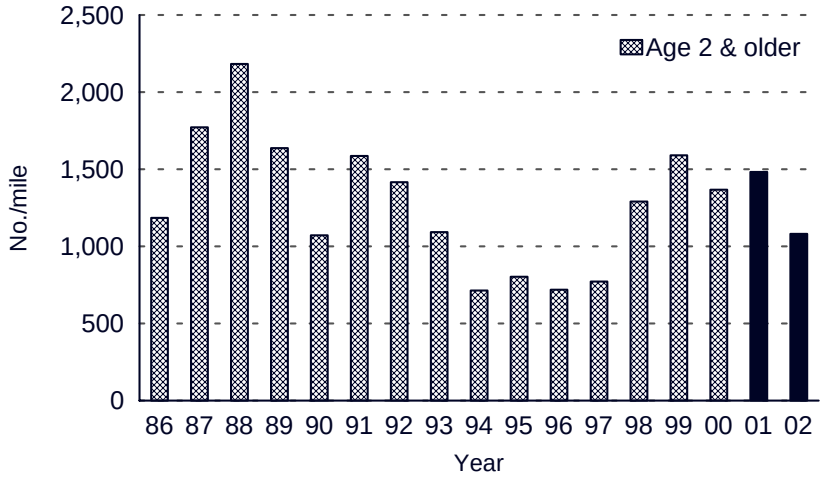

Figure 16. Rainbow trout populations in the Norris section of the Madison River, 1986-2002, spring estimates. Data for 2001 & 2002 are provisional pending completion of age samples.

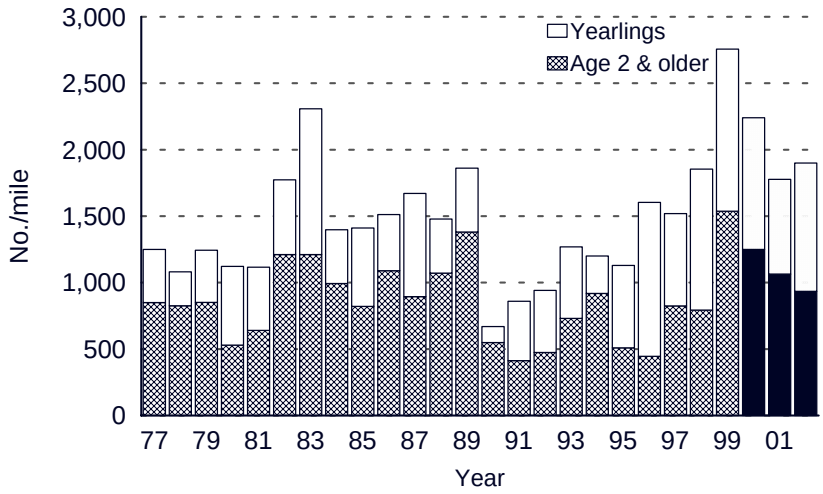

Figure 17. Brown trout populations in the Pine Butte section of the Madison River, 1977-2002, fall estimates. Data for 2000 - 2002 are provisional pending completion of age samples.

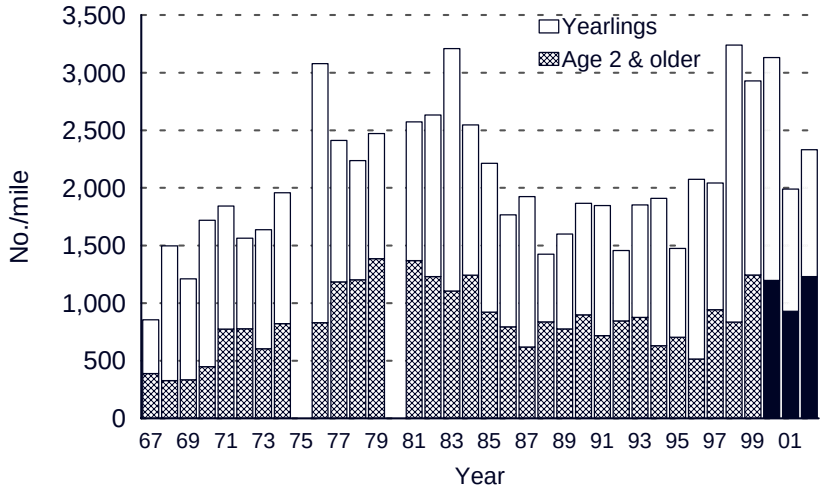

Figure18. Brown trout populations in the Varney section of the Madison River, 1967-2002, fall estimates. Data for 2000 - 2002 are provisional pending completion of age samples.

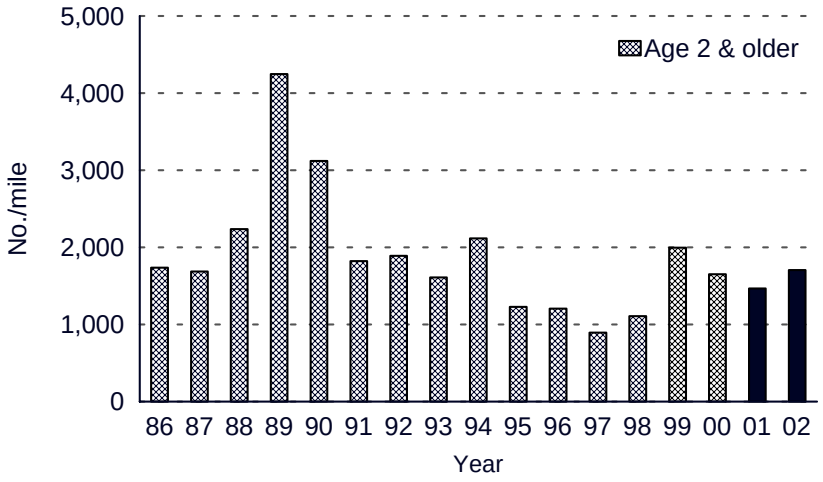

Figure 19. Brown trout populations in the Norris section of the Madison River, 1986-2002 spring estimates. Data for 2001 & 2002 are provisional pending completion of age samples.

Trout Growth

Comparison of trout weight-at-length between FWP population estimate sections (Figure 5) indicates that both rainbow and brown trout attain similar weight at any given length throughout the river. Comparisons were made for rainbow and brown trout by season only for those years when data was collected in both sections in the same season (Figures 20-23). Additional evaluation using average weight by inch-class and weight-at-length by age class is on-going.

Whirling Disease

Results of 2001 sentinel fish studies became available in 2002. Infection rates in 2001 were high at the South Slide side channel, Kirby, and Pine Butte sections, but are moderate to low at the North Slide side channel (Vincent 2003, pers.comm.).

A study entitled “Effects of Spring Creek Rehabilitation on Infection Rates of Whirling Disease in Trout” was conducted on two spring creeks, including $3 Spring Creek (Appendix C). The MadTAC contributed $1,000 toward conducting this study.

Information on whirling disease, including numerous links, is available online at whirlingdisease.org.

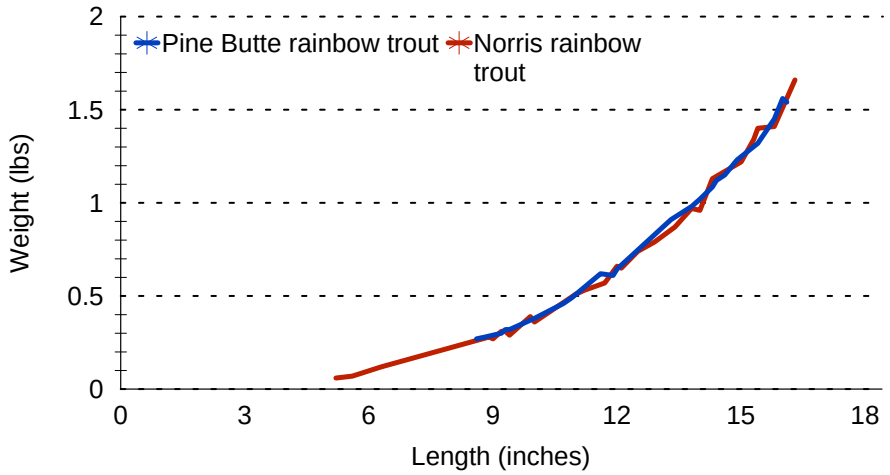

Figure 20. Average weight at average length for aged rainbow trout in the Pine Butte and Norris sections of the Madison River, 1986, 1989, 1992, and 1994-96.

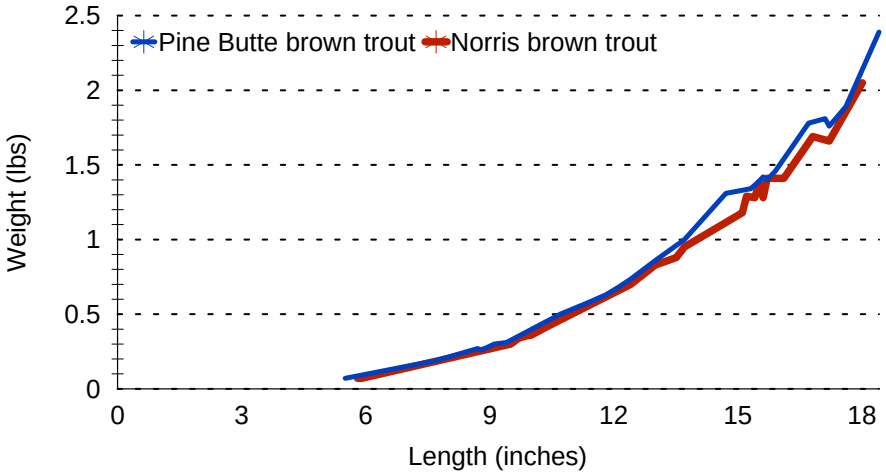

Figure 21. Average weight at average length for aged brown trout in the Pine Butte and Norris sections of the Madison River, 1986, 1989, 1992, and 1994-96.

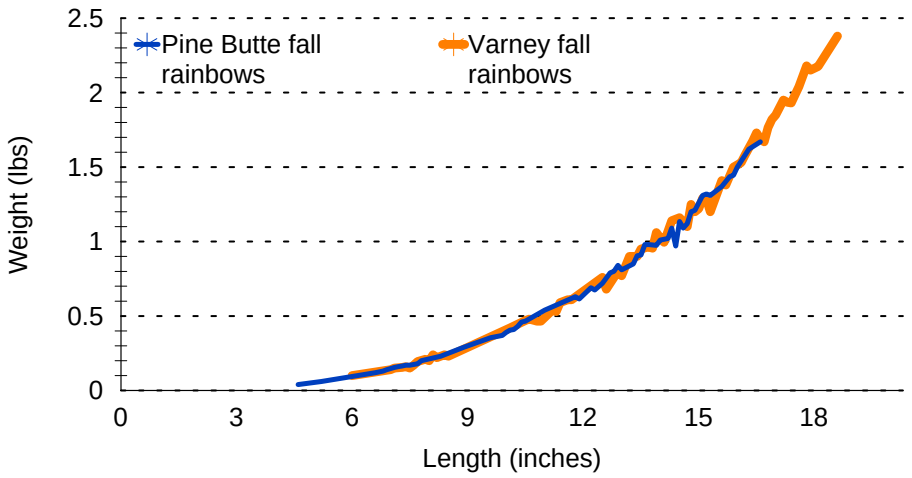

Figure 22. Average weight at average length for aged rainbow trout in the Pine Butte and Varney sections of the Madison River, 1980-1999.

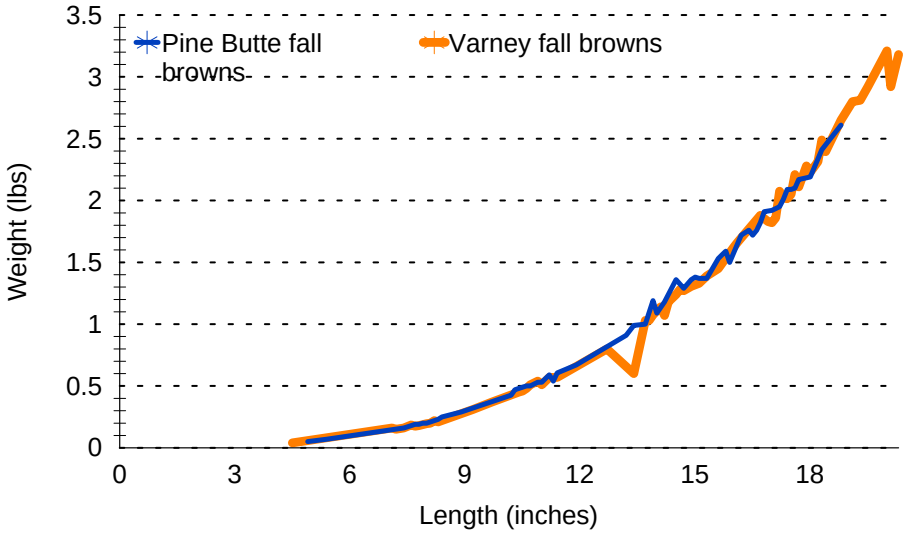

Figure 23. Average weight at average length for aged brown trout in the Pine Butte and Varney sections of the Madison River, 1980-1999.

Madison Bypass

The radio telemetry system installed in the Bypass Reach operated well, with all four antennae detecting test transmitters and implanted fish. Occasionally, the receivers register a code indicating that undecipherable radio signals are being detected, but we were unable to determine if these are caused by the hydropower system and/or associated radio signals in the Bypass, or if these are problems with detecting radio transmitters implanted in the fish.

Movements of radio tagged fish in the Bypass section of the Madison River were monitored continuously beginning in July when two radios were implanted in fish. These two fish moved from the surgery release site to a point slightly upstream near where they had been captured. They then showed little movement through October, so an attempt to sight them via snorkeling (Figure 24) was made to determine if they each still held their radio and were simply holding their locations, or if they had dropped their radio. Visibility was poor in the river, and no fish were seen during the snorkel attempt. The radio receiver continued detecting those two transmitters through the season. Ten additional radios were deployed throughout the Bypass in November. All implanted fish were fully recovered prior to release.

Only one of the fish implanted in November exhibited movement into the narrow area of the river monitored by an antenna. This was a slight downstream movement into the vicinity of the Madison Powerhouse. This 13.7-inch rainbow trout showed movements into and out of the range of the antenna for increments of up to two weeks.

Figure 24. A snorkeler searches for radio tagged fish in the Bypass Reach of the Madison River, October 2002.

Temperature Monitoring

Optic StowAway temperature recorders were deployed throughout the Madison River to document air and water temperatures (Figure 10). Table 2 summarizes the data collected at each location in 2002, and Appendix D1 contains thermographs for each location. Appendix D2 contains thermographs at selected locations showing the 24-hour diurnal temperature fluctuation of each site around the warmest date of the year.

Biological and Biocontaminant Monitoring

Samples collected by the PPL Montana Water Quality Monitoring Program in August, 2001, documented the arrival of the New Zealand Mudsnail (NZMS) in the lower Madison River near the Norris Bridge. Previously, NZMS were known to exist only in the upper Madison River above Raynolds Pass Bridge and in Darlinton Ditch along the lower Madison River (MFWP 2002a). Over 70 river miles separated these two populations. The population detected in the lower river is only a few miles upstream of the Darlinton Ditch head gate.

Additionally, NZMS were detected in other popular trout angling locations in the western United Sates, including the upper Missouri and upper Beaverhead rivers in Montana.

The Cobblestone FAS was closed to all public use in 2000 in an effort to eliminate the inadvertent spread of the NZMS from that location.

Bioassays were conducted to fulfill the conditions of the July 2001 Decision Notice regarding treatment of Darlinton Ditch to eradicate NZMS (Figure 25). Bayluscide killed 100 percent of test snails exposed to at least 48 exposure units of Bayluscide. An exposure unit is attained by multiplying the Bayluscide concentration in mg/l (ppm) by the number of hours of exposure, so 4 mg/l x 12 hours of exposure = 48 exposure units. However, bioassays also showed that potassium permanganate was not effective in neutralizing Bayluscide. Significant neutralization of 4 mg/l Bayluscide did not occur until 24 hours of exposure to 50 mg/l potassium permanganate. A potassium permanganate concentration of about 2 mg/l is effective in neutralizing the fish control pesticides rotenone and antimycin relatively within a matter of hours.

An additional factor that required consideration was the previously mentioned detection of NZMS in the Madison River near the Norris Bridge, only a few miles upstream of the Darlinton Ditch headgate. These NZMS were found in samples collected in August 2001, only one month after the Darlinton Ditch Decision Notice was issued. The presence of NZMS in the river sample was not known until spring 2002, when the consultant identifying the samples notified FWP and PPL Montana of their presence. Since Darlinton Ditch transports irrigation water from the Madison River, NZMS will undoubtedly invade the ditch with river water.

While bioassays showed that Bayluscide will effectively kill NZMS, a supplemental Decision Notice was issued in September 2002 (MFWP 2002c) explaining the decision not to proceed with the treatment of Darlinton Ditch due to the inability of potassium permanganate to

Table 2. Maximum and minimum temperatures (°F) at selected locations in the Madison River Drainage, 2001. Air and water temperature data were recorded 4/20-10/2 (7944 readings) unless otherwise indicated. Thermographs for each location are in Appendix D1.

	Site	Max	Min
Water	Hebgen inlet	80.42	40.29
	Hebgen discharge	65.99	36.36
	Hebgen-Quake river section	66.90	35.61
	Quake Lake outlet	63.20	35.97
	Kirby Bridge	70.19	33.91
	McAtee Bridge	72.45	31.82
	Ennis Bridge	75.57	33.29
	Ennis Reservoir Inlet	79.10	34.57
	Ennis Dam	74.95	38.18
	Bear Trap Mouth	78.78	36.50
	Norris	79.35	36.49
	Blacks Ford	81.46	35.22
	Cobblestone[1/]	81.93	35.90
	Headwaters S.P.[2/] (Madison mouth)	NA	44.25
Air	Kirkwood Store	91.62	23.43
	Slide	100.72[3]	23.52
	Wall Creek HQ	97.99	23.51
	Ennis Fisheries Office	100.43	23.40[4]
	Ennis Dam	95.73	23.46
	Norris	93.24	24.77
	Cobblestone	90.31	23.52

[1/] Cobblestone logger was dewatered from approximately August 7 (1030 hrs) through September 4 (1830 hrs).
[2/] Original Headwaters State Park logger failed to record properly, was replaced on July 3. The replacement logger was dewatered approximately July 31 (0830 hrs) through August 7 (2100 hrs) and again August 17 (0830 hrs) through August 24 (1400 hrs). Replacement logger recorded 4412 points, including the dewatered periods.
[3/] The maximum temperature detectible by the recorders is approximately 100.7F.
[4/] The minimum temperature detectible by the recorders is approximately 23.4°F.

Figure 25. New Zealand Mudsnail bioassay set-up.

quickly neutralize the Bayluscide and the near proximity of a new and unstoppable source of NZMS to Darlinton Ditch. The MadTAC authorized $8,000 toward the purchase and installation of fence at the Cobblestone Fishing Access Site to prevent cattle trespass and the subsequent potential spread of NZMS to the Madison River, but only about $2,800 was needed. The MadTAC also authorized $10,000 toward the cost of conducting the eradication treatment. None of the $10,000 was used, so reverted back to the MadTAC.

Preliminary studies at Darlinton Ditch by MSU personnel indicate many functional groups of aquatic invertebrates have significantly lower densities in the area the snail has invaded compared to areas it hasn't invaded (Cada, pers. comm.). These functional groups include scrapers, scraper-collector gatherers, collector gatherers and collector filterers. Taxa that show significantly lower densities in the presence of the snail include Chironomidae and Baetidae, which show the largest decrease. However, these decreased densities only have been seen in the November 2000 samples, significantly lower densities were not observed in samples collected in June 2001. MSU personnel are conducting additional studies in Darlinton Ditch to further assess the impacts if NZMS on other aquatic invertebrates, and have been sampling monthly at Darlinton since May 2002 (Cada, pers.comm.). To date, samples from May-August 2002 and Feb 2003 have been processed. These samples have shown that grazing by the NZMS seems to increase the variability of chlorophyll biomass. Areas of the stream not occupied by NZMS have very consistent levels of chlorophyll biomass.

Additional information on Aquatic Nuisance Species is on the web at www.anstaskforce.gov and www.protectyourwaters.net, and for NZMS specifically, is available at www.esg.montana.edu/aim/mollusca/nzms.

The Montana Aquatic Nuisance Species Management Plan was submitted to the U.S. Fish & Wildlife Service Aquatic Nuisance Species Task Force by the Governor of Montana on October 15, 2002. The USFWS ANS Task Force reviewed and accepted Montana's Plan in November, qualifying Montana for federal assistance with preventing and controlling the dispersal of ANS in Montana (Gallagher, 2002 pers.comm.). Alaska, Maine, and Massachusetts also had plans approved by the ANS Task Force in November.

The ANS Task Force has $ 850,000 available for 2003, and there are currently 13 management plans (11 state plans and 2 Interstate plans) approved by the ANS Task Force.

Westslope Cutthroat Trout Conservation and Restoration

In March 2002, the Montana First Judicial District Court issued a decision on the Cherry Creek Native Fish Introduction Project denying the litigants petition for judicial review. Planning for the project resumed, and treatments were scheduled to begin August 1. However, litigants served a 60-day notice on June 3 that they intended to file suit in federal district court. A 60-day Notice is required to alert potential defendants that a suit may be filed against them, however, the suit cannot be filed until 60 days after the filing of the Notice. FWP decided to again delay the implementation of the project in face of the threatened legal challenge, but the litigants did not file a lawsuit in 2002.

The EA prepared for the Sun Ranch Pond treatment was available for public comment from December 21, 2001, through January 21, 2002. No comments were received. A decision was made to proceed with the preferred alternative of treating the pond, estimated to contain 5 acre-feet of water, with antimycin at a rate of 4 parts per billion (ppb) to eradicate all fish in the pond (MFWP 2002b). Only 4 ppb were necessary because the low rate of water exchange in the pond, approximately 0.36 gallons/minute (~520 gallons/day), would allow a long exposure period, and antimycin persists for an extended period of time in cold water. The treatment was conducted on February 28, 2002.

The pond was ice covered, and water temperature was 34^{o}F. Three of the sentinel fish cages were checked prior to initiating the treatment (2 in the pond and one in the outlet stream), and all sentinels were alive and in good condition (Table 3). The treatment was conducted by drilling holes in the ice at 8 locations, mixing a portion of the antimycin solution with 2-3 gallons of pond water in a 5 gallon bucket, and pumping the mixture back under the ice (Figures 26 & 27). Care was taken to insure the terminal end of the tubing was inserted deep enough into the pond so that the antimycin solution exited the tubing under the ice. Air temperatures during the treatment were in the 20's, but the wind was problematic. Some icing of the tubing occurred, so a plastic tarp was used during the treatment to shield equipment and personnel from the wind, which eliminated icing problems. The entire treatment took less than 4 hours to complete. After the antimycin application was completed, the pond aeration system was run for 2 hours to facilitate circulation of the antimycin in the pond.

Table 3. Water chemistry conditions and fate of sentinel albino rainbow trout held in minnow cages during and after antimycin treatment of the Sun Ranch Pond. All sentinel fish were deployed February 23, and the treatment was conducted on February 28.

Cage	date	No. fish	live/dead	water pH	water temp.
Outlet	2/28/02	9	9/0	N/A	N/A
	3/1/02	9	9/0	N/A	N/A
	3/6/02	9	9/0	N/A	N/A
	3/8/02	9	9/0	7.3	40
	3/20/02	9	9/0	8.1	40
	4/24/02	9	9/0	7.6	N/A
Pond –north cage	2/28/02	10	10/0	8.5	34
	3/1/02	10	4/6	N/A	N/A
	3/6/02	10	0/10	8.2	34
Pond – mid cage	3/6/02	13	0/13	8.2	34
Pond – south cage	2/28/02	12	12/0	8.5	34
	3/1/02	12	10/2	N/A	N/A
	3/6/02	12	0/12	8.2	34

Sentinel fish were checked on March 1, less than 24 hours after the treatment. The same cages were checked that had been examined on the previous day prior to the treatment. There were no mortalities of the fish in the cage in the outlet stream (Table 3), which was at a location approximately 67 feet in vertical elevation below the pond outlet. Spring flow entering the outlet creek increased the discharge of the outlet stream, diluting any antimycin that exited the pond. The north and south cages in the pond were examined and found to contain some dead fish (Figure 28). Fish killed by antimycin toxicity become pale due to the inability of the skin pigments to remain active as the cell dies. Dead sentinel fish were removed from the cages each time the cages were checked. Examination of the cages on March 6 revealed that all sentinel fish in the pond cages were dead, but all sentinel fish in the outlet cage were alive. The outlet cage was left in place for long-term monitoring and removed on April 24. There were no mortalities of sentinel fish in the outlet cage.

In October 2002, nearly 600 young-of-the-year WCT were stocked from the Sun Ranch Hatchery into the Sun Ranch rearing pond.

Hebgen Reservoir Tributary Spawning

During the initial year of study, tributaries of Hebgen Reservoir were monitored to enumerate rainbow trout redds, to assess fry production, and to evaluate spawning potential. Results are reported in Watschke and McMahon (2002) and summarized here.

Figure 26. Generator and peristaltic pump being used to apply Fintrol to the Sun Ranch Pond.

Figure 27. Fintrol (brown cloud at end of tubing) exiting tubing into the Sun Ranch Pond.

Figure 28. Live and dead sentinel albino rainbow trout in a minnow trap in the Sun Ranch Pond less than one day after application of the antimycin. The paler fish on the left died from antimycin toxicity.

Rainbow trout redds were identified in 9 of the 11 surveyed Hebgen Reservoir tributaries. Almost 4400 redds were counted, with one stream accounting for over half the total. An upstream trap on that tributary captured 2507 female and 657 male rainbow trout migrating upstream. The migration peaked from mid-May to early June.

Attempts to capture and enumerate outmigrating juvenile rainbow trout met with limited success. Large numbers of fry were observed during the summer in the areas where redds were constructed, but only 26 fry were captured in downstream juvenile nets that were operated 3 days each week from June 20 through August 16. Electrofishing in those areas in October revealed far fewer rainbow trout fry than had been observed visually, and that rainbow trout fry, as well as brook trout and juvenile brown trout, were strongly associated with beds of aquatic vegetation in the stream near the spawning areas.

Plans for 2003 include continued enumeration of redds and spawning adults, spawning habitat quality and quantity assessment, and investigation of the fate of rainbow trout fry produced in the tributaries.

Madison River Tributary Enhancement

Streamflow measurements conducted on Indian Creek in 2001 & 2002 show an average loss of about 8 cubic feet/second (cfs) as water travels from the county road bridge at the CB Ranch to the U.S. Highway 287 Bridge (Table 4), a distance of over 3 miles. In most years, Indian Creek goes dry before reaching the Madison River, due in part to

Table 4. Indian Creek stream discharge measurements during 2001 & 2002 at the county road bridge near the CB Ranch and the U.S. 287 Bridge, and the volume of water lost to percolation between the bridges. All measurements are in cubic feet per second (cfs).

Date	CB Ranch	US 287	volume lost
4/4/01	16.8	6.0	10.8
5/25/01	95.2	91.8	3.4
6/26/01	39.8	32.6	7.2
7/11/01	0.8	dry	0.8
5/2/02	10.8	1.0	9.8
5/21/02	123.0	113.5	9.5
6/13/02	72.8	73.3	-0.5
6/25/02	182.1	170.4	11.7
7/9/02	29.2	23.7	5.5

irrigation withdrawal, and in part to natural percolation of water into the bench over which Indian Creek flows.

FWP has a year-round instream flow right of 48 cubic feet per second (cfs) in Indian Creek, measured at the Highway 287 Bridge. However, the priority date is 1985, so all other water right holders in the Indian Creek basin are senior to FWP.

Surveys of the dewatered portion of Indian Creek from U.S. Forest Service land to the Madison River reveal marginal spawning habitat. The predominant substrate of the stream channel is very large gravel and cobble (Figure 29). Accumulations of spawning-size gravel are rare, and tend to be at a relatively high elevation within the channel or in very small pockets behind larger cobbles, boulders, and debris accumulations. The absence of natural hydrologic forces in the dewatered portion of Indian Creek prevents the conveyance of gravel from upstream areas and recruitment of gravel from localized hydrologic function, and also prevents distribution and accumulation of gravel within the channel. There are two areas of gravel accumulations that could be used for spawning provided other needs are met.

Approximately 475 feet downstream of the Indian Creek Ditch head gate is a large gravel deposit, extending for a distance of about 370 feet downstream. This very large deposit of spawnable gravel is deposited at this location when a headgate on the adjacent Indian Creek Ditch is opened to evacuate gravel from the ditch (Figure 30). Near the mouth of Indian Creek are more gravel deposits that are suitable for spawning (Figure 31). On the date this area was surveyed the stream was dry from the vicinity of the CB Ranch Bridge to the Indian Creek Ranch buildings. Water resurfaced in the channel about ¼ mile above the stream mouth and a minor volume of streamflow, estimated at 7 cfs, was flowing into the river. Three brown trout were observed in a pool of water about ¼ mile above the mouth of the stream.

Figure 29. Indian Creek stream channel near mouth, looking upstream, showing the large substrate particles. Note the gravel deposit behind the debris pile on the right margin of the stream channel.

Figure 30. Downstream view of Indian Creek above the CB Ranch. The turbulent water on the right of the photo is re-entering Indian Creek from the Indian Creek Ditch.

Figure 31. Indian Creek substrate near the confluence with the Madison River.

Habitat enhancement of $3 Spring Creek was conducted by planting vegetation along the stream margin, replacing an undersized culvert under the county road to drain an impounded area created by the culvert, and by constructing fence along both sides of the stream to prevent cattle access, which will allow over-widened sections of the stream to narrow and deepen through natural hydrologic process. The MadTAC contributed $4,650 to the project to assist with costs of stream fencing, culvert replacement, and streamside vegetation planting.

CONCLUSIONS AND FUTURE PLANS

The Madison Reservoir grayling population continues to persist at low levels. The extent of ice-gorging of the Madison River immediately south of Ennis Reservoir may play a role in spawning success of grayling. Scouring of the substrate by the ice may improve substrate conditions for grayling eggs that will be deposited there the following spring. FWP will begin monitoring the upriver extent of ice-gorging conditions through visual observations and correlating those conditions with subsequent information on juvenile grayling abundance collected through field sampling and angler contacts.

Due to the time required to process and analyze samples of sentinel fish used for annually monitoring the severity of whirling disease infection, actual infection rates are not known for up to a full calendar year after the samples are removed from the river. After removal from the river, sentinel fish must be reared for an additional 90 days in uninfected water at the Pony facility, then processed and sent to the Washington Animal Disease Diagnostic Laboratory in Pullman, Washington. Populations of rainbow trout in the upper Madison River continue to be affected by whirling disease, but have shown recovery from

the low levels seen in the mid 1990's. For the past several years sentinel fish have shown high rates and severity of infection thought to be related to drought conditions.

Radio implanted fish in the Bypass section of the Madison River have shown no extensive movement since monitoring began in July 2002. Currently 12 fish are implanted with radio tags. Additional tags will be deployed at least twice annually for the next several years.

Examination of weight-at-length for rainbow trout and brown trout in the population estimate sections of the Madison River illustrates that both exhibit consistent weight-at-length throughout the river. Comparison of weight-at-length for aged fish in the Pine Butte, Varney, and Norris sections reveals little noticeable difference for either species throughout the river. These preliminary analyses used average weight and average length of aged fish for comparison. Age was not incorporated into the analyses. Ongoing analyses are examining weight-at-length by size class and weight-at-length by age class.

The expansion of New Zealand Mudsnails, both in number and distribution, will continue to be monitored through the 2188 Biological and Biocontaminant monitoring program, as well as through monitoring by aquatic biologists at Montana State University and an on-going Montana State University Master of Science project studying the effects of NZMS in Darlinton Ditch. FWP reversed it's decision to conduct an eradication effort of NZMS in Darlinton Ditch after NZMS were found in samples collected under PPL Montana's Biological and Biocontaminant monitoring program in the Madison River just upstream from a headgate that draws river water into Darlinton Ditch.

The Sun Ranch Westslope Cutthroat Trout Program will continue in 2003 if adequate populations of genetically pure WCT can be identified and are able to withstand donation of gametes for development of a broodstock. Approximately 590 WCT fry from two donor streams were stocked in the Sun Ranch Pond in October 2002. FWP, the U.S. Forest Service, and BLM are in the process of developing a plan to identify Madison River tributary streams where WCT restoration and enhancement is feasible.

In the absence of threatened litigation, cooperators in the Cherry Creek Native Fish Introduction Project will enter into discussions in the spring of 2003 to determine the feasibility of initiating that project in 2003.

In 2003, FWP will more actively participate in the Hebgen Reservoir tributary study in order to efficiently assume those activities when the MSU Master of Science project ceases, and to initiate fieldwork on other 2188 Articles related to Hebgen Reservoir fisheries.

Also in 2003, FWP will conduct evaluation of on-river and tributary irrigation projects to determine and rank possible fisheries mitigation and enhancement measures such as screening to exclude fish entrainment into ditches and water leasing to enhance tributary flow.

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Appendix A

Description of young-of-the-year Arctic grayling beach seining locations in Ennis Reservoir, and catch at each site. See Figure 2 for site locations.

Species abbreviations:

AG	arctic grayling
MWF	mountain whitefish
WSu	white sucker
UC	Utah chub
Rb	rainbow trout
LL	brown trout

October 2, 2002

Site and time seined	AG	MWF	Note
parallel to shore along west end of willows at edge of Peterson property ($1000 house) (Fig 2, site 1) 1145 hrs	0	0	One Rb 460mm(18") One juvenile LL (50 mm) Dozens y-o-y Utah chubs (UC) & White suckers (WSu). Green filamentous algae abundant throughout Meadow Creek Bay (Figure A1)
parallel to shore between west end of willows at edge of Peterson property & willows at Meadow Creek Fishing Access Site (Fig 2, site 1) 1300 hrs	0	0	3 y-o-y LL (118, 109, 94 mm) Dozens of y-o-y WSu & UC
Meadow Cr. Bay parallel to shore along east end of willows at Meadow Lake FAS (Fig 2, site 1) 1345 hrs	0	0	dozens y-o-y WSu & UC
South shoreline of reservoir west of Fletchers Channel 1445 hrs	0	2	MWF (139, 112 mm) (Figure A2) dozens of y-o-y WSu & UC
South shoreline east of Moore's Creek mouth 1500 hrs	1	0	AG (135 mm) dozens of y-o-y WSu & UC
South shoreline ½ mile west of river mouth 1550 hrs	0	0	dozens of y-o-y WSu & UC

Figure A1. Beach seine with filamentous green algae and juvenile suckers and chubs in Meadow Creek Bay, Ennis Reservoir.

Figure A2. Young-of-the-year Mountain Whitefish captured during beach seining in Ennis Reservoir.

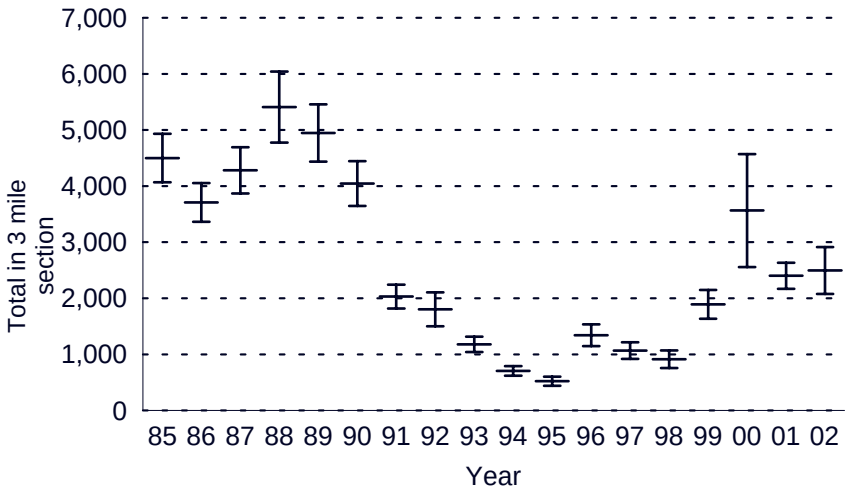
Appendix B

Population estimates (total number in section± 80 percent Confidence Intervals)
of age 2 & older rainbow and brown trout in the Madison River

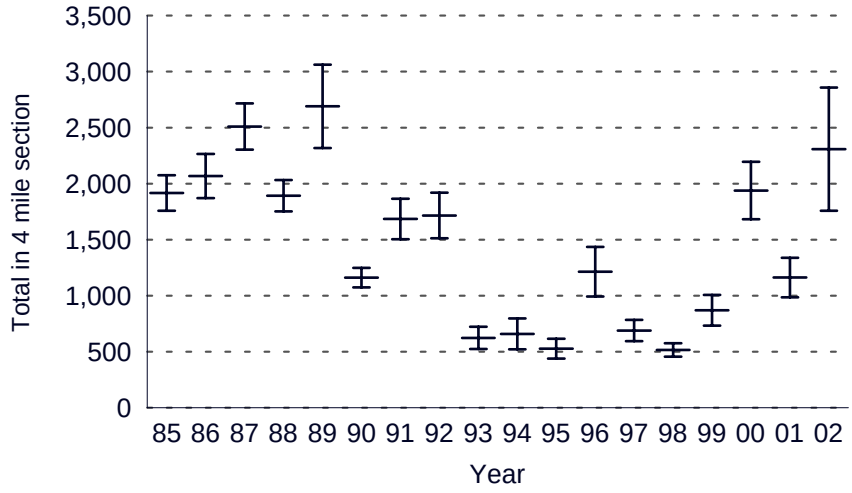
section lengths

Pine Butte – 3 miles
Varney – 4 miles
Norris – 4 miles

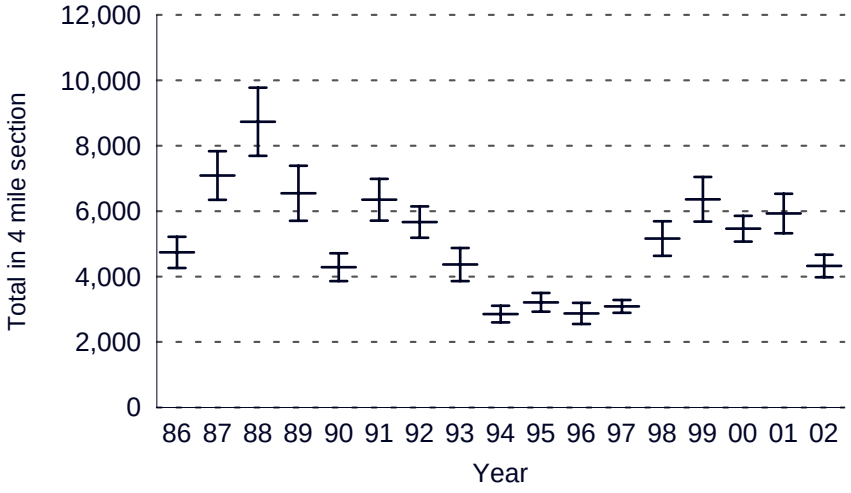
Pine Butte
Rainbow Trout
Age 2 & older



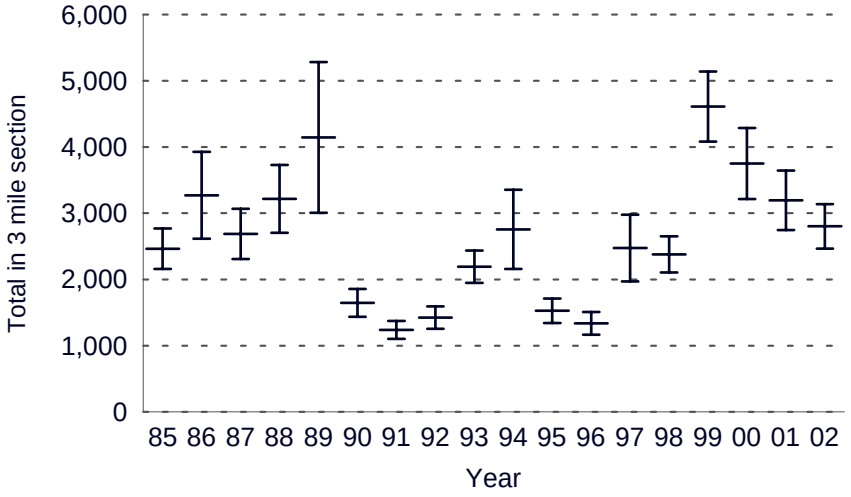
Varney
Rainbow Trout
Age 2 & Older



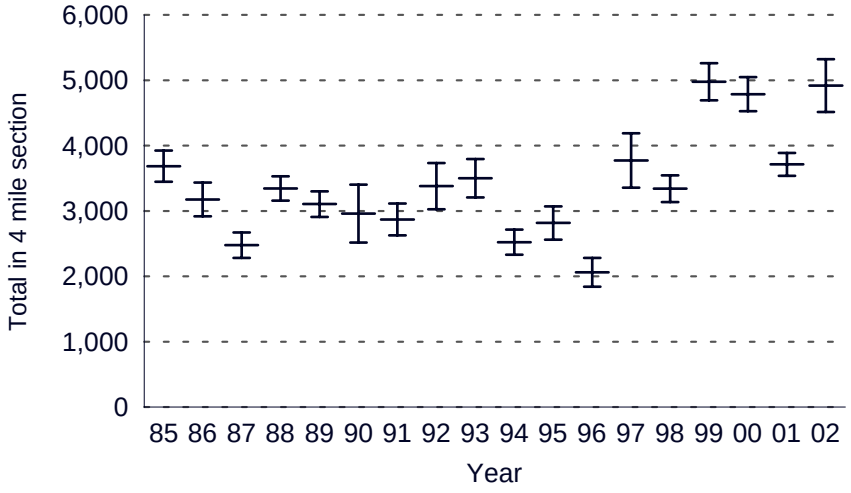
Norris
Rainbow Trout
Age 2 & Older



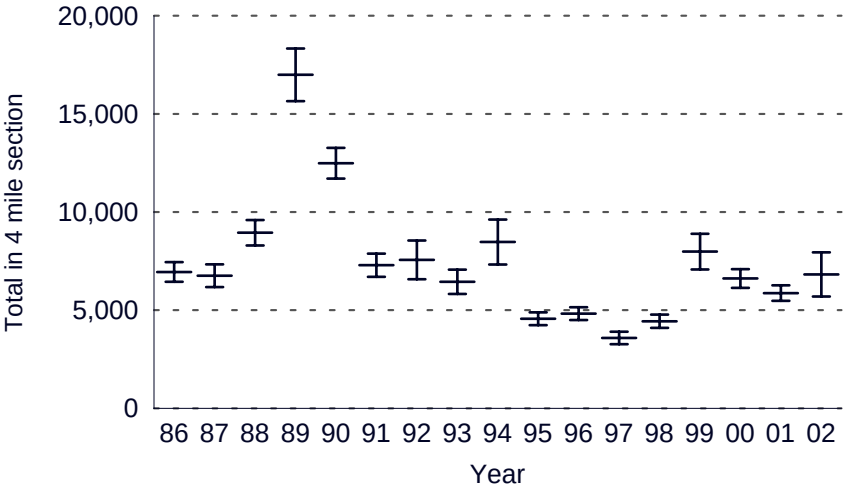
Pine Butte
Brown Trout
Age 2 & older



Varney
Brown Trout
Age 2 & Older



Norris
Brown Trout
Age 2 & Older



Appendix C

Effects of Spring Creek Rehabilitation on Infection Rates of Whirling Disease in Trout

Interim Report to the Whirling Disease Initiative

Patrick Byorth, Fisheries Biologist
Montana Fish, Wildlife, and Parks

December 2002

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EXECUTIVE SUMMARY

Valley-bottom spring creeks are undergoing a transformation from agricultural nuisance to recreational amenity. New landowners are spending time and money restoring historically degraded spring creeks to improve trout fisheries. However, because spring creeks are stable hydrologically and thermally and are biologically productive, they are ideal locations to propagate the parasite that causes whirling disease. By rehabilitating spring creeks, impacts of whirling disease on local trout populations may be either amplified or lessened, depending on the outcome. This study is designed to document the extent of whirling disease infections in trout in two Montana spring creeks prior to restoring them to suitable habitat. In July 2003, a fence was constructed around Three Dollar Spring Creek in the Madison drainage to exclude cattle from trampling the channel. Exclusion of cattle should enable natural processes to narrow and deepen the stream channel. A culvert under the county road was replaced to drain an impounded area created by the culvert (a likely source of whirling disease infections). The East Gallatin Spring Creek is slated for major restoration in 2003. An entirely new meandering channel will be constructed with more natural channel dimensions and habitat unit sequences.

To test for the presence of whirling disease and infection rates, rainbow, brook and brown trout fry were placed in sentinel cages at two locations and three periods of exposure in each stream (Table 1). Sentinel fish were exposed in each stream for 10 days, reared at the Pony Whirling Disease Lab for 80 days, and sacrificed for analysis of rates of infection by Myxobolus cerebralis. These results are pending.

In each stream, two 500 ft study reaches were designated within proposed restoration reaches. Thermographs were installed to monitor temperature throughout 2002. Within each study reach, we conducted a habitat survey. We classified each habitat unit as riffle, pool, or glide and measured channel characteristics at three cross-sections within each habitat unit. We measured wetted channel width and water depth at three locations per transect and noted instream cover. We also measured discharge at suitable cross sections within each study reach. Habitat parameters are summarized in Table 2.

To characterize the fish community within each study reach, we conducted multiple pass electrofishing surveys in each study reach. In both spring creeks, limited fish abundances and poor year-class distribution reflected over-widened and shallow conditions. Results of electrofishing are summarized in Table 3. In the Three Dollar Spring Creek, all but a few brown trout were young-of-the-year, indicating that the stream is important for spawning and rearing of brown trout, but that very limited habitat exists for juvenile and adult trout. Mottled sculpin were abundant in both reaches. In the East Gallatin Spring Creek, only a few fish were captured, primarily brook trout.

Habitat quality and fish abundances demonstrate the degraded condition of each spring creek. When whirling disease infection data are returned we will have a fairly complete picture of conditions in the spring creeks before restoration. A full year after restoration is complete in both streams, we will repeat surveys to document the affects of restoration on fish communities and extent of whirling disease infections.

Table 1. Location, dates and fish species used in sentinel live cage study of whirling disease infection in two spring creeks.

Spring Creek	Species	Dates	Sites
Three Dollar	Rainbow trout Brown trout	Jan. 30 – Feb. 8, 2002	County road (Upper) Property boundary (Lower)
	Rainbow trout Brown trout Brook trout	March 13 – March 23, 2002	County road Property boundary
	Rainbow trout	July 16 – July 26, 2002	County road Property boundary
East Gallatin	Rainbow trout Brown trout	Jan. 31 – Feb. 10, 2002	Head of springs (Upper) Confluence (Lower)
	Rainbow trout Brown trout Brook trout	March 14 – March 24, 2002	Head of springs Confluence
	Rainbow trout	July 16 – July 26, 2002	Head of springs Confluence

Table 2. Summary of pre-treatment habitat conditions in two spring creeks slated for restoration.

Study Reach	Mean wetted width (ft)	Mean Depth (ft)	Discharge (cfs)	% Habitat Type		
				Riffle	Pool	Glide
Three Dollar Upper Reach	14.6	0.29	1.83	56	9	35
Three Dollar Lower Reach	13.7	0.29	2.76	59	7	34
East Gallatin Spring Creek – Upper Reach	13.7	0.31	2.36	44	49	7
East Gallatin Spring Creek – Lower Reach	12.5	0.33	4.18	10	90(beaver pond)	0

Table 3. Summary of fish captured in two-pass electrofishing surveys of two spring creeks.

Study Reach	Species	# captured	Length Range (inches)
Three Dollar Upper Reach	Brown trout	319 12	< 5.0 5.1- 8.6
	Mottled sculpin	18	2.5-3.7
Three Dollar Lower Reach	Brown trout	108	1.8 – 3.6
	Mottled sculpin	Very abundant Not enumerated	
East Gallatin Spring Creek – Upper Reach	Brook trout	3	2.2-6.3
	Mottled sculpin	1	4.3
East Gallatin Spring Creek – Lower Reach	Brook trout	10	1.9-7.2
	Brown trout	1	6.2

Appendix D1

Temperature recordings from monitoring sites on the Madison River
(See Figure 10 for locations)

Appendix D2

Diel water temperature fluctuations during the warmest 24 hours at selected sites.